Introduction to Statistics in Political Science

Political Science 812 Fall 2018

Lecture Location Ingraham 225
Lecture Time Mondays & Wednesdays, 9:30am–10:45pm
Instructional model classroom instruction
Credits 3 credits

Instructor Alex Tahk
Email atahk@wisc.edu
Office 212 North Hall
Office Hours By appointment via vyte.in/tahk

Teaching Assistant Dmitrii Kofanov
Email kofanov@wisc.edu
Office 121 North Hall
Office Hours Mondays & Wednesdays, 11am–noon, or by appointment

Course description

Political scientists employ increasingly sophisticated statistical methods. Understanding these methods —and new ones that will undoubtedly become available—requires a firm foundation in mathematical statistics. This course is intended to provide this foundation so that students can continue their methods training with subsequent courses in the department (PS 813 and PS 818) as well as other advanced courses and self-learning. It will also provide some applications that illustrate concepts and introduce students to empirical political science research.

Learning outcomes

Students will be able to:

- understand fundamental concepts of probability theory and causal inference
- compute probabilities, expected values, and variances of random variables
- describe fundamental concepts of point estimation, confidence intervals, and hypothesis testing
- produce original data analysis using t-tests, chi-squared tests of independence, bivariate regression, and other techniques

How the credit hours are met

This class meets for two 75-minute class periods of lecture and one 50-minute section each week over the fall semester and carries the expectation that students will work on course learning activities (reading and working on research project) for about 3 hours out of classroom for every class period.

Prerequisites

This course has no formal prerequisites. However, you are assumed to have been exposed to differential calculus and basic integral calculus. No background in linear algebra is needed.

Sections

The weekly sections will focus primarily on statistical computing, including instruction in using statistical software and practical computer exercises.

Grading

Grading will be divided between problem sets (15%), a midterm exam (25%), a final exam (45%), and a data analysis report (15%).

Problem sets

There will be short problem sets nearly weekly. The problem sets will be posted on Canvas. These will be graded on a check-plus/check/check-minus/zero basis. Late assignments are strongly discouraged. A pattern of late assignments will result in a grade penalty. Assignments more than one week late will not be accepted.

The problem sets will cover both theory and application. You are welcome to discuss the problem sets with each other and run programs together, but the final write-ups should be your own. Also, note that simply copying R or Stata output without reformatting is not appropriate.

Midterm exam

There will be an in-class midterm on **October 29**. In addition to counting towards your final grade, the exam should serve as an indicator of your progress in the course.

Final exam

There will be a *cumulative* final exam held during exam week. The date will be scheduled during the first two weeks of classes.

Data analysis report

Students will complete a report employing basic methods to answer an empirical question of their own choosing. Data will typically come from a common political science data set (American National Election Study, Correlates of War, etc.). A literature review is unnecessary. Papers should be roughly five pages and are due on the last class (**December 12**).

Statistical computing

Computational components of the problem sets will make use of R, an implementation of the S statistical programming language. It can be downloaded for free from http://www.r-project.org/. We will also use Stata at the end of the course when we cover linear regression.

Textbooks

The primary textbook for this course is:

> Imai, Kosuke. 2018. *Quantitative Social Science: An Introduction*. Princeton: Princeton University Press.

This book will be supplemented with additional notes, posted on Canvas, for some topics.

Many other treatments of this material are also available. Two good possibilities are:

DeGroot, Morris H., and Mark J. Schervish. 2011. *Probability and Statistics, 4th edition.* Boston: Addison Wesley.

Larsen, Richard J., and Morris L. Marx. 2011. *Introduction to Mathematical Statistics and Its Applications, 5th edition.* Upper Saddle River, N.J.: Prentice Hall.

Wackerly, Dennis D., William Mendenhall III, and Richard L. Scheaffer. 2008. *Mathematical Statistics with Applications, 7th edition.* Belmont, Calif.: Brooks/Cole.

For a bit more or less rigorous treatment, respectively, consider:

Casella, George, and Roger L. Berger. 2001. *Statistical Inference, 2nd edition.* Belmont, Calif.: Duxbury Press.

Craig, Bruce A., David S. Moore, and George P. McCabe. 2010. *Introduction to the Practice of Statistics*. New York: W. H. Freeman.

Academic integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW–Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity

Accommodations for students with disabilities

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform me of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. I will work either directly with the student you or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

Diversity and inclusion

Institutional statement on diversity

Diversity is a source of strength, creativity, and innovation for UW–Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin–Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background—people who as students, faculty, and staff serve Wisconsin and the world.

Topics and readings

The syllabus is organized around topics rather than by day. We will typically spend around one week per topic, but may spend more or less. I suggest you read through the material before class and again after its discussed in class. Even a quick skim of the material beforehand is very beneficial.

Causality

Reading: Imai, Chapter 1–2

Measurement

Reading: Imai, Chapter 3

Prediction

Reading: Imai, Chapter 4

Probability and combinatorics

Reading: Imai, Chapter 6.1
Supplemental notes, Part 1

Conditional probability

Reading: Imai, Chapter 6.2
Supplemental notes, Part 2

Random variables and distributions

Reading: Imai, Chapter 6.3
Supplemental notes, Part 3

Large sample theorems

Reading: Imai, Chapter 6.4
Supplemental notes, Part 4

Estimation

Reading: Imai, Chapter 7.1
Supplemental notes, Part 5

Hypothesis testing

Reading: Imai, Chapter 7.2
Supplemental notes, Part 6

Linear regression with uncertainty

Reading: Imai, Chapter 7.3
Supplemental notes, Part 7